Karolinska Institutet

Institutionen för Fysiologi och Farmakologi,
Sektionen för Anestesiologi och Intensivvård

A NOVEL DRUG AND DEVICE IN ANESTHESIA
WITH FOCUS ON BREATHING AND UPPER AIRWAY PHYSIOLOGY

AKADEMISK AVHANDLING
som för avläggande av medicine doktorsexamen vid Karolinska Institutet offentligen försvaras på engelska i Nanna Svartz Auditorium, Karolinska Sjukhuset Solna

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av
Åse Lodenius
Leg. läkare

Huvudhandledare:
Docent Malin Jonsson Fagerlund
Karolinska Institutet
Institutionen för Fysiologi och Farmakologi
Sektionen for Anestesi och Intensivvård

Bihandledare:
Docent Johan Ullman
Karolinska Institutet
Institutionen för Fysiologi och Farmakologi
Sektionen for Anestesi och Intensivvård

Professor Lars I Eriksson
Karolinska Institutet
Institutionen för Fysiologi och Farmakologi
Sektionen for Anestesi och Intensivvård

Fakultetsopponent:
Professor Jaideep J Pandit
University of Oxford
Nuffield Department of Anaesthetics,
John Radcliffe Hospital, Oxford, UK

Betygsnämnd:
Professor Mikael Bodelsson
Lunds Universitet
Enheten för Anestesi och Intensivvård

Associate Professor Gunilla Islander
Lunds Universitet
Enheten för Anestesi och Intensivvård

Docent Peter Sackey
Karolinska Institutet
Institutionen för Fysiologi och Farmakologi

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ABSTRACT

Anesthesia-related airway complications are associated with hypoxia due to inability to secure or maintain the airway with subsequent insufficient ventilation and gas exchange. This thesis has explored the impact on airway integrity and respiratory regulation of two anesthetic compounds frequently used for sedation and a novel principle for oxygenation in patients at risk of hypoxia, in order to further improve patient safety during sedation and induction of anesthesia.

Using a crossover study design, sedation with dexmedetomidine and its effect on regulation of breathing was investigated and compared to sedation with propofol in healthy young men. An impairment of both peripheral and central regulation of breathing, with a similar magnitude of effect during dexmedetomidine and propofol sedation, was found. Incidentally, upper airway obstruction and apneas were discovered which led to investigations on upper airway collapsibility. Pharyngeal critical closing pressure was measured during dexmedetomidine sedation and compared to sedation with propofol at low and moderate infusion rate of sedative drug. A difference in passive pharyngeal closing pressure between dexmedetomidine and propofol could not be demonstrated at either infusion rate of sedation. Clinically significant episodes of apnea during induction of sedation with both drugs were displayed in the two studies, but to a somewhat more pronounced degree with dexmedetomidine.

High-flow nasal oxygenation during apnea using THRIVE (transnasal humidified rapid-insufflation ventilatory exchange) was evaluated describing the change of arterial blood gases and pH that it induces in patients undergoing elective laryngeal surgery in general anesthesia. Oxygenation proved to be well maintained and a lower rate of rise of arterial carbon dioxide than in earlier studies of apneic oxygenation was confirmed, permitting an extended safe apneic period. Since THRIVE maintained oxygenation during apnea for at least 30 minutes it might be of benefit during rapid sequence induction of anesthesia. Therefore, THRIVE and its effect on peripheral oxygen saturation was compared to traditional preoxygenation with a facemask in rapid sequence induction in 80 patients presenting for emergency surgery. In the facemask group 12.5% of patients desaturated below 93% vs none in the THRIVE group.

In conclusion, sedation with dexmedetomidine impairs regulation of breathing, affects upper airway collapsibility and induces apnea to a similar extent as propofol sedation. High flow nasal oxygenation using THRIVE maintains oxygenation and causes a slow rise in arterial carbon dioxide. This enables extension of the apnea time and indicates possible benefit when used for oxygenation during airway management.

Keywords: *anesthesia, sedation, hypnotics and sedatives, airway management, pharynx, airway obstruction, hypoxia, hypercapnia, artificial respiration, pulmonary gas exchange, postoperative complications*

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